National Park Service
U.S. Department of the Interior

Southeast Utah Group

2282 SW Resource Blvd.
Moab, UT 84532

435 719-2100 Phone
435 719-2300 Fax

RESEARCH 2003

RESOURCE MANAGEMENT DIVISION

Charles Schelz / Biologist

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CANYONLANDS NATIONAL PARK

1) Project title:

RECONSTRUCTING THE GEOMETRY AND PALAEOCLIMATE OF THE CEDAR MESA AND WHITE RIM SANDSTONE (PERMIAN)

Name of principal investigator:
Name: Dr Nigel Mountney Phone: 44 1782 583171 Email: n.p.mountney@keele.ac.uk

Name of institution represented:
Keele University

Additional investigator(s):
Name:Oliver Jordan Phone:44 1782 583171 Email:gga00@keele.ac.uk
Name:Alison Jagger Phone:44 1782 583171 Email:a.jagger@esci.keele.ac.uk

Purpose of study:

This field-based research project aims to examine and document the sedimentology and paleoenvironment of a succession of Permian-age, arid-climate continental successions exposed within the Paradox Basin of the Canyonlands District, SE Utah. Field-based data is being used to develop and constrain quantitative predictive models for eolian and desert-margin evolution within ancient arid sedimentary systems. This is being achieved through an ongoing outcrop study of mixed fluvial, aeolian and lacustrine strata within the Permian Cedar Mesa Sandstone and Elephant Canyon Formations. The project is helping to determine the response of desert margin deposits to cyclical changes in climate.

2) Project title:

THE EVOLUTIONARY STABILITY OF FREQUENCY DEPENDENT DYNAMICS IN THE SIDE-BLOTCHED LIZARD

Name of principal investigator:
Name: Mr Ammon Corl Phone: 831-459-4022 Email: corl@biology.ucsc.edu

Name of institution represented:
University of California - Santa Cruz

Additional investigator(s):
Name:Shawn Kuchta Phone:831-459-4022 Email:skuchta@darwin.ucsc.edu
Name:Barry Sinervo Phone:831-459-4022 Email:sinervo@biology.ucsc.edu

Purpose of study:
This phylogeographic project will concentrate upon how the frequency dependent dynamics of U. stansburiana have changed over evolutionary time.

3) Project title:

MONITORING THE COLORADO PIKEMINNOW POPULATION IN THE MAINSTEM COLORADO RIVER VIA PERIODIC POPULATION ESTIMATES

Name of principal investigator:
Name: Mr Douglas Osmundson Phone: 970-245-9319 Email: doug_osmundson@fws.gov

Name of institution represented:
US Fish & Wildlife Service

Additional investigator(s):
Name:Andrew Scott Phone:970-245-9319 Email:n/a
Name:Chuck McAda Phone:970-245-9319 Email:chuck_McAda@fws.gov
Name:Bob Burdick Phone:970-245-9319 Email:bob_burdick@fws.gov
Name:Thad Bingham Phone:970-245-9319 Email:thad_bingham@fws.gov
Name:Rick Smaniotto Phone:970-245-9319 Email:n/a
Name:Dale Ryden Phone:970-245-9319 Email:dale_ryden@fws.gov

Purpose of study:
To periodically provide population estimates of the Colorado River population of the endangered Colorado pikeminnow. Such estimates were made during 1991-1994 and 1998-2000. Our office will initiate a new three-year study beginning in 2003. The study area extends from Palisade, Colorado to the confluence with the Green River in Utah (185 miles). The lower 40 miles of the study area is within Canyonlands National Park.

4) Project title:

THE ROLE OF BIOLOGICAL SOIL CRUSTS IN SOIL NUTRIENT CYCLES AS INFLUENCED BY SOIL SURFACE DISTURBANCE, CLIMATE CHANGE AND ANNUAL GRASS INVASION

Name of principal investigator:
Name: Dr Jayne Belnap Phone: 435-719-2333 Email: jayne_belnap@usgs.gov

Name of institution represented:
U.S. Geological Survey

Additional investigator(s):
Name:Buck Sanford Phone:303-871-3534 Email:rsanford@du.edu Name:Sylvia Englund Phone:801-581-5927 Email:englund@biology.utah.edu Name:Dave Bowling Phone:303-585-9853 Email:bowling@biology.utah.edu Name:Jim Ehleringer Phone:801-581-7623 Email:ehleringer@bioscience.utah.edu

Purpose of study:
Models indicate the presence of a large carbon (C) sink at temperate latitudes in the northern hemisphere. Over thirty percent of lands both globally and in the United States consist of semi-arid or arid landscapes. Very little is known about carbon dynamics in these regions. Biological soil crusts, composed primarily of cyanobacteria, algae, lichens and mosses, can completely cover plant interspaces in undisturbed areas, and constitute 70 percent or more of the living ground cover. These soil crusts can be the dominant source of nitrogen (N) for vascular plants. They fix C at a high rate and are critical for soil stability and aggregate formation, which is important in C storage. They also absorb significant amounts of CH4. In areas where precipitation is low and soils have low fertility, native plants often rely on intact biological soil crusts to provide increased water and nutrient flow to the broadly scattered vegetation. Thus, there are many ways in which biological soil crusts influence biogeochemical cycles and the structure and productivity of the vascular plant community. Soil surface disturbance, invasive plants, and climate change have the potential to dramatically alter the structure and function of biological soil crusts. The current combination of recreational use and livestock grazing is resulting in unprecedented levels of surface disturbance on many arid lands. In regions that did not have substantial amounts of surface disturbance in the Holocene, biological soil crusts disappear readily when trampled by animals or vehicles. Exotic annual grasses are invading many of these areas. Trampling and invasion results in reduced cover and changes in the species composition of biological soil crusts. This, in turn, leads to changes in processes such as decomposition, N and C fluxes, soil moisture, and nutrient availability to vascular plants. Decreases of only 1 percent of soil organic carbon in the top 10 cm of rangeland soils is equivalent to the total C emissions from all croplands nation-wide.

Changes in climate regimes, such as a shift in the summer monsoonal boundaries in the western United States, are expected to influence the composition and physiological

functioning of biological soil crusts. Various crust components have different photosynthetic and respiration responses to temperature and moisture. In addition, different crusts have different methane fluxes. Therefore, changes in the timing or amount of temperature and precipitation is expected to alter soil C and N fluxes through changes in physiological response or crustal composition. This, in turn, can significantly impact vascular plant productivity.

This project will establish how alterations in species composition by surface disturbance, invasive grasses, and/or climate change may affect N and C inputs and fluxes, in different soils under different climatic regimes. Because current and expected changes in land use and climate will occur over millions of acres in western rangelands, impacts to soil crusts have the potential for dramatically affecting C cycles, N cycles, and vascular plant productivity over much of the western United States. In addition, semi-arid and arid ecosystems represent over one-third of the Earth's terrestrial surface, and most are covered by biological soil crusts. As human impacts are escalating both regionally and globally in these drier regions, the research questions posed in this proposal have significant implications for global C budgets as well.

5) Project title:

PALEOMETEOROLOGY AND PALEOCLIMATE FROM ANCIENT WIND-BLOWN SANDSTONES

Name of principal investigator:
Name: Dr David Loope Phone: (402) 472-2647 Email: dloope1@unl.edu

Name of institution represented:
University of Nebraska-Lincoln

Additional investigator(s):
Name:Steve Fischbein Phone:9402) 472-2663 Email:rockhead@bigred.unl.edu
Name:Eric Waiss Phone:(402) 472-2663 Email:funkthulhu@yahoo.com

Purpose of study:
The wind-blown sandstones of the Colorado Plateau record 150 million years of changing environmental conditions. This proposal seeks to extract this record through field study of Permian through Jurassic sandstones in Canyonlands National Park and the surrounding region.

6) Project title:

EXOTIC ANNUAL GRASSES IN WESTERN RANGELANDS: PREDICTING RESISTANCE AND RESILIENCE OF NATIVE ECOSYSTEMS TO INVASION

Name of principal investigator:
Name: Dr Jayne Belnap Phone: 435-719-2333 Email: jayne_belnap@usgs.gov

Name of institution represented:
U.S. Geological Survey

Additional investigator(s):
Name:Dave Evans Phone:(501) 575-7093 Email:devans@comp.uark.edu
Name:Merith Reheis Phone:(303) 236-1270 Email:mreheis@usgs.gov
Name:Rich Reynolds Phone:(303) 236-1303 Email:rreynolds@usgs.gov
Name:Van Williams Phone:303-236-1289 Email:vwilliams@usgs.gov
Name:Dave Miller Phone:(650) 329-4923 Email:dmiller@usgs.gov
Name:Buck Sanford Phone:(303) 871-3534 Email:rsanford@du.edu

Purpose of study:
Introduced Mediterranean annual grasses currently comprise 50-85 percent of vascular plant cover in over two-thirds of the West. One of these species, Bromus tectorum, alone dominates over 100 million acres the Intermountain West, with an additional 62 million at high risk from invasion (EPA-EMAP, unpublished; Whisenant 1990). On-going conversion of native vascular plant communities to annual grasses is a threat to the population viability of many native plant and animal species, through direct plant replacement or changes in habitat characteristics, such as timing and quantity of food and cover and altered nutrient cycles.

It has long been thought that surface disturbance is a necessary prerequisite for annual grass invasions into established perennial plant communities. However, annual grasses have been seen to invade undisturbed ecosystems as well. In addition, annual grass invasions are often patchy, with some soils apparently uninvadable. Agronomists have long known that one of the most important soil characteristics affecting plants is the availability of soil nutrients. The relative levels of specific soil nutrients, rather than disturbance, successfully explained site-specific patterns of Bromus invasion in SE Utah grasslands. This project will determine if invasion susceptibility of other ecosystems in other geographic regions can be similarly predicted by variations in soil characteristics attributable to geomorphic and pedogenic processes within a given watershed. Experiments will be be conducted to determine if managers can alter soil chemistry in a way to favor native grass establishment. In addition, Bromus may alter many ecosystem components that prevent native plant re-establishment. This project will monitor soils in a newly-invaded area, and document what alterations in soil chemistry and biology occur. Results from this project will be used to develop management strategies to avoid new Bromus invasions, and for already-invaded areas, to develop techniques to enhance native plant re-establishment.

With many millions of acres currently dominated by non-indigenous annual grasses, and 62 million acres of rangeland habitat highly susceptible to conversion, annual grasses are emerging as a major factor to be considered as we contemplate the future of rangeland ecosystems. It is critical that we understand whether managers can stop or buffer these invasions, and/or restore habitats after conversion. Determining factors that precipitate or facilitate invasion may provide management tools for preventing dominance of aliens in areas where the population viability of species is of concern, and facilitate re-establishment of lost habitat. In addition, understanding how annual grass invasion changes natural ecosystem processes, such as nutrient availability, water availability, and soil microbial systems and how these changes affect re-establishment of native perennial plants, will enhance efforts to restore lost habitat.

7) Project title:

IMPACTS OF CLIMATIC CHANGE AND LAND USE ON THE SOUTHWESTERN U.S.

Name of principal investigator:
Name: Dr Jayne Belnap Phone: 435-719-2333 Email: jayne_belnap@usgs.gov

Name of institution represented:
U.S. Geological Survey

Additional investigator(s):
Name:Jason Neff Phone:303-236-1306 Email:jason_neff@usgs.gov
Name:Rich Reynolds Phone:303-236-1303 Email:rreynolds@usgs.gov
Name:Frank Urban Phone:303-236-4790 Email:frank_urban@usgs.gov
Name:Marith Reheis Phone:303-236-1270 Email:mreheis@usgs.gov

Purpose of study:
The population of the southwestern United States has grown rapidly over the past two decades and is projected to increase greatly over the next several decades. As the population has grown, climatic variations that would have affected relatively few people in the past will impact the lives of millions. Rapid and wide-spread climatic changes, such as those seen thousands and hundreds of years ago in the region and those projected for the future, may profoundly change the character of the region. Arid and semi-arid regions of the southwestern U.S. are among the most sensitive regions to changes in climate and land use, but the potential interactions between climatic change and land use are largely unknown (http://climweb.cr.usgs.gov/info/sw_new/swmap.html).

U.S. Geological Survey and collaborating scientists are seeking to understand how climate and how land use have influenced surficial geologic processes that modify landscapes and ecosystems. Such understanding is then used to model the landscapeDs response to future changes in climate and land use over time scales of seasons, of a few years, and of a few decades, so that information and interpretations can be applied by federal, state, and local

agencies, as well as by Native American governments, for their land-use planning and management of resources.

Project scientists work with ecologists, hydrologists, geographers, cartographers, and archeologists to address questions about (bold titles indicate activity at Canyonlands National Park):
(1) the causes and timing of changes in alluvial environments (rivers, streams, hillslopes), such as flooding, the cutting and filling of arroyos, and sediment discharge;
(2) the role of eolian dust for soil fertility, invasion of exotic species, hydrology, and surface stability in deserts;
(3) the interaction of physical and biologic processes critical for ecosystem functions;
(4) how climate in the southwest has varied over decades, centuries, and millennia;
(5) how future climatic variations will affect the Southwestern land surface (in terms of erosion, sand-dune activity, dust-storm frequency, flooding, landslides,);
(6) how past climatic changes and environments affected prehistoric cultures.

General Project Goals
+ Understand how past climatic change affected land surface: soil loss, fluvial erosion and alluviation, sand-dune mobilization, ecosystems, under time frames of past decades, centuries, and millennia.
+ Understand todayDs interplay among climate, land use and surface processes (geologic and ecologic).
+ Understand the impacts of future climate on land surface under the following time frames: seasons; El NiTo/La NiTa cycles; multi-year wet/drought periods; and decades, as atmospheric CO2 increases.

A major goal is to interact with federal, state, and local government agencies as well as non-governmental organizations to provide information useful for management decisions regarding land-surface vulnerability to wind erosion. Another goal is to provide to managers and other parties ongoing remote sensing and meteorological monitoring bearing on the vulnerability of the land to natural and human disturbances.

Specific goals for Canyonlands work
+ Understand geologic origins of soil nutrients and the interactions of soil compounds and plants.
+ Understand geomorphic controls on plant distribution
+ Understand the recent (past several decades, centuries, millennia) geologic/geomorphic evolution of the ecosystem to reveal patterns of surface stability and instability.
+ Recognize areas vulnerable to wind erosion and soil loss.
+ Understand conditions of cheatgrass (and other exotic plants) invasion to predict areas most vulnerable to expansion and to help devise mitigation strategies.

8) Project title:

ANNUAL FOREST LAND INVENTORY OF UTAH

Name of principal investigator:
Name: Mr Michael J. Wilson Phone: 801-625-5388 Email: mjwilson@fs.fed.us

Name of institution represented:
Rocky Mountain Research Station

Additional investigator(s):
Name:Roger Boyer Phone:801-625-5541 Email:rboyer@fs.fed.us

Purpose of study:
Gather information on the quantity and quality of forest resources, growth, mortality, removals, and forest health.

9) Project title:

BCS PROJECT / BARRIER CANYON STYLE ROCK ART DOCUMENTATION.

Name of principal investigator:
Name: Mr David Sucec Phone: 801-359-6904 Email: davids@networld.com

Name of institution represented:
BCS PROJECT

Additional investigator(s):
Name:Craig Law Phone:435-752-2327 Email:claw@wpo.hass.usu.edu

Project title:
BCS PROJECT / Barrier Canyon Style Rock Art Documentation.

Purpose of study:
The objectives of the BCS PROJECT documentation project are to record all Barrier Canyon style rock art images with archival photographic prints (gelatin-silver and ultra-stable color prints), to create a complete inventory of the documented sites, and to generate a scholarly description and analysis of the imagery.

10) Project title:

POPULATION ESTIMATE OF HUMPACK CHUB IN CATARACT CANYON, COLORADO RIVER RECOVERY IMPLEMENTATION

Name of principal investigator:
Name: Mr Michael Hudson Phone: 435-259-3781 Email: michaelhudson@utah.gov

Name of institution represented:
Utah Division of Wildlife Resources

Additional investigator(s):
Name:Melissa Trammell Phone:928-774-5500 Email:mtrammell@swca.com
Name:Julie Jackson Phone:435-259-3782 Email:juliejackson@utah.gov
Name:Paul Badame Phone:435-259-3780 Email:paulbadame@utah.gov
Name:Rich Valdez Phone:435-752-9606 Email:valdezra@aol.com

Purpose of study:
This is a three-year population estimate of humpback chub in Cataract Canyon on the Colorado River. The study will also examine the relationship between ISMP catch rates and population size.

11) Project title:

POPULATION ESTIMATE OF COLORADO PIKEMINNOW IN THE LOWER GREEN RIVER, UPPER COLORADO RIVER RECOVERY IMPLEMENTATION PROGRAM PROJECT NO.22J

Name of principal investigator:
Name: Mr Michael Hudson Phone: 435-259-3781 Email: michaelhudson@utah.gov

Name of institution represented:
Utah Division of Wildlife Resources

Additional investigator(s):
Name:Julie Jackson Phone:435-259-3782 Email:juliejackson@utah.gov
Name:Paul Badame Phone:435-259-3780 Email:paulbadame@utah.gov

Purpose of study:
To obtain a reasonable estimate of adult Colorado pikeminnow abundance and survival in the lower Green River, Utah

12) Project title:

VEGETATION DATA COLLECTION IN SUPPORT OF THE U.S. GEOLOGICAL SURVEY - NATIONAL PARK SERVICE VEGETATION CLASSIFICATION AND MAPPING PROGRAM AT CANYONLANDS NATIONAL PARK

Name of principal investigator:
Name: Mr James Von Loh Phone: 303-721-9219 Email: jvonloh@e2m.net

Name of institution represented:
National Park Service

Additional investigator(s):
Name:Sarah Boyes Phone:303-721-9219 Email:sboyes@e2m.net Name:Pete Williams Phone:970-374-2504 Email:williapa@flattops.net Name:Frank (Buddy) Smith Phone:435-755-0606 Email:fsmith@mtwest.net Name:Daniel Niosi Phone:303-721-9219 Email:dniosi@e2m.net Name:Janet Coles Phone:303-443-6736 Email:janetcoles1@netscape.net

Purpose of study:
The National Park Service (NPS) and U.S. Geological Survey (USGS) are cooperating to produce detailed vegetation classifications and digital databases, including vegetation maps, as part of the National Biological Information Infrastructure Program (NBII).

13) Project title:

DOWNSTREAM EFFECTS OF FLAMING GORGE DAM ON RIPARIAN VEGETATION ALONG THE GREEN RIVER

Name of principal investigator:
Name: Dr David Cooper Phone: 303-499-6441 Email: dcooper@rmi.net

Name of institution represented:
Colorado State University

Purpose of study:
To understand the effects of current and past Green River regulation by Flaming Gorge Dam on riparian vegetation along the Green River. My initial work will focus on the Fort Bottom area as a significant hydrologic data set has been developed by the National Park Service Water Resources Division. I will establish homogenous plots to represent the main vegetation types in the area. Each plot will be identified with a GPS location, and can then be analyzed within the hydrologic framework established by NPS hydrologist Brian Cluer. This data set will allow me to analyze the composition of vegetation along hydrogeological

gradients. This vegetation composition will be compared with the vegetation from other Green River locations in Lodore Canyon, Whirlpool Canyon, Split Mountain Canyon, Ouray National Wildlife Refuge, Island Park, and Gray Canyon, as well as Deerlodge Park and Yampa Canyon along the unregulated Yampa River in Dinosaur National Monument. The overall goal is to develop an analysis of the riparian vegetation for the entire middle and lower Green River. We will investigate patterns of vegetation that reflect adjustment to Flaming Gorge Dam regulation. I will also excavate tamarisk and young cottonwood to accurately determine the year each plant established. The goal of this investigation is to understand whether Flaming Gorge Dam has created more suitable conditions for tamarisk invasion, and the role of tamarisk in sediment accumulation and channel narrowing.

14) Project title:

EFFECTS OF BURNING AND CUT-STUMP TAMARISK CONTROL METHODS ON RIPARIAN VEGETATION COMMUNITY COMPOSITION OVER TIME

Name of principal investigator:
Name: Ms Rebecca Harms Phone: (928) 523-0648 Email: rsh33@dana.ucc.nau.edu

Name of institution represented:
Northern Arizona University

Additional investigator(s):
No co-investigators

Purpose of study:
Tamarisk (deciduous Tamarix spp.), an invasive exotic shrub, threatens the biodiversity of riparian systems throughout the Southwest, and controlling tamarisk is often a high priority for land managers. Previous research has focused on the efficacy of control methods in killing tamarisk. However, the effects of tamarisk control treatments on native vegetation are undocumented and poorly understood. Using a retrospective analysis of sites treated from 1-35 years ago, I will investigate the current vegetative community composition in riparian areas throughout California, Nevada, Arizona, Utah and New Mexico. My research will compare two common methods of removing tamarisk, burning and cutting, with a no-treatment control to determine which method(s) results in the most desirable riparian vegetation community, as determined by management objectives (e.g. wildlife habitat, habitat restoration, etc.). The end result will provide an evaluation of long-term effects of current tamarisk management techniques to land managers throughout the Southwest and will enable land managers to better choose a method for removing tamarisk that also promotes a return to the desired riparian ecosystem condition.

15 Project title:

AMPHIBIAN RESEARCH AND MONITORING INITIATIVE (ARMI): PACIFIC NORTHWEST AND ADJACENT ARIDLANDS--CANYONLANDS NATIONAL PARK INDEX SITE

Name of principal investigator:
Name: Dr Tim Graham Phone: 435-719-2339 Email: tim_graham@usgs.gov

Name of institution represented:
USGS--Canyonlands Field Station

Additional investigator(s):
Name:R. Bruce Bury, Ph.D. Phone:541-7544382 Email:bruce_bury@usgs.gov
Name:Michael J. Adams, Ph.D. Phone:541-7588857 Email:mjadams@usgs.gov

Purpose of study:
1. To develop effective monitoring protocols that will provide the proportion of habitat units that host breeding populations of amphibians within selected survey areas, in a design that allows broad inference to all of Canyonlands National Park.
2. To develop methods to effectively estimate population density and abundance in sentinel sites that will be worked intensively over each season.
3. Work with Southeast Utah Group NPS staff to enhance and expand existing water monitoring program to ensure amphibian habitats are being monitored, and to add any parameters of importance to amphibians that may not be included in current park monitoring program (e.g., dissolved organic matter, and community attributes such as plankton composition).
4. Monitor the incidence of disease in Canyonlands amphibians.
5. Integrate findings in Canyonlands National Park with a national amphibian monitoring program.
6. Make latest monitoring data available to the NPS via web accessible database within 3 months of data collection.
7. Compile and interpret trend information on amphibians that we collect at regular intervals and place findings into local, regional, and national contexts.

16 Project title:

AMPHIBIAN POPULATION DYNAMICS AND INVERTEBRATE DIVERSITY OF SALT CREEK CANYON, CANYONLANDS NATIONAL PARK: DIFFERENCES CORRELATED WITH PRESENCE/ABSENCE OF 4WD VEHICLE USE

Name of principal investigator:

Name: Dr Tim Graham Phone: 435-719-2339 Email: tim_graham@usgs.gov

Name of institution represented:

USGS--Canyonlands Field Station

Additional investigator(s):

No co-investigators

Purpose of study:

The objectives of this study are to: 1) establish riparian and aquatic invertebrate and amphibian monitoring locations in the vicinity of vegetation monitoring stations; 2) evaluate a variety of sampling methods for invertebrates and amphibians to determine which provides the best estimates of community structure (relative abundance and species composition); 3) identify which taxa, guilds, functional groups of invertebrates and/or amphibians will make optimum indicators of riparian and aquatic ecosystem recovery in Salt Creek; 4) recommend the best monitoring techniques for target indicator groups based on results of this research; 5) work with CANY staff to develop, test and refine a monitoring plan that will guide sampling, analysis, and interpretation of the data collected over time, and that can be extended to other parts of CANY as well as other units of SEUG.

17 Project title:

NIGHT SKY MONITORING OF PARKS OF THE SOUTHEAST UTAH GROUP

Name: Charles Schelz **Email:** charlie_schelz@nps.gov

Name of institution represented: National Park Service

Purpose of study
To develop protocols and gather baseline data on night sky light levels at the four units of the Southeast Utah Group. This project will result in the development of a Night Sky Long-Term Monitoring Plan and a report that will be a template for future reports. This report will detail all protocols, fieldwork required, and test site locations, it will also provide baseline data and analysis for comparison with future monitoring.

Objective 1:
A "Night Sky Long-Term Monitoring Plan" that outlines, in detail and with examples, all protocols, database management, and analysis to be performed at each test site. It will also clearly specify night sky monitoring needs and objectives. And will provide a clear understanding of how the monitoring program will support management information needs.

This plan will identify site-specific current resource impacts. It will also attempt to address future concerns and problem areas. It will set monitorinig management standards for resource conditions and will identify and assign priorities to areas of greatest concern.

Objective 2:
An initial report of the first completed round of Night Sky monitoring based on the new system recommended in the Night Sky Long-Term Monitoring Plan (Objective 1). This will include all test sites at all four units of the Southeast Utah Group..

18 Project title:

HISTORIC VEGETATION ANALYSIS THROUGH THE USE OF REPEAT PHOTOGRAPHY AT THE SOUTHEAST UTAH GROUP.

Name: Charles Schelz **Email:** charlie_schelz@nps.gov

Name of institution represented: National Park Service

Purpose of study

Little is known of the historic vegetative cover of any of the habitats of the Southeast Utah Group. The pre-grazing condition of the vegetation has been described anecdotally, but any scientific measurement or quantitative description does not exist. The use of photography to gather this information has become our last chance to determine the pre-grazing conditions. Domestic livestock grazing was introduced into the area of the Southeast Utah Group during the late 1870's. This gives us little latitude for locating historic photographs considering photography was a new invention in the 1840's. Powell's second Colorado River expedition of 1872 had a photographer (E.O Beaman) on board and many of the original glass plates survive. Many of these photos are along the Green and Colorado Rivers but some are also in the uplands above the river. The river environment is presently being studied by Belnap and Webb (personal comm. 1998) from the confluence of the Colorado and Green Rivers south through Cataract Canyon. The Belnap and Webb study, which is utilizing historic photos, is concentrating on the river environment without much analysis of the upland vegetation communities. I propose to search out all existing historic photos that are available and piece together a picture of our upland communities as they existed before the advent of domestic livestock grazing. I also propose setting up permanent long-term monitoring photo stations at the historic photo sites that have a clear and identifiable vegetative element.

This characterization of the ecosystem vegetative change and, in particular, the condition of pristine conditions of the varied habitats of the SEUG is rated as a **Top Priority Critical Research Need** by the 1993 Southeast Utah Group Research Plan. This work may also facilitate the understanding of the history of the invasion of exotic species into the area and the impacts of visitor use.

OBJECTIVES: Gather baseline historic photographic data and develop a long-term photographic monitoring program on vegetation change in Arches and Canyonlands National Parks, and Natural Bridges and Hovenweep National Monuments (The Southeast Utah Group).

1) Locate all existing historic photographs and in particular pre-1880 photos of the area that encompasses the Southeast Utah Group.

2) Determine the location of each photo with vegetative analysis possibilities and establish a permanently marked and documented photo-station for past, present, and future analysis of vegetation change.

3) Analyze historic and repeat photos for species composition and cover change. Also, to look at visitor use impacts.

4) Produce a final report, and lay the foundation for subsequent reports and monitoring that will assist National Park Service managers in developing resource management plans that could protect habitats of the Southeast Utah Group. This information will help in assessing impacts of internal and external operations, and visitor impacts.

19) Project title:

MEXICAN SPOTTED OWL INVENTORY AT CANYONLANDS NATIONAL PARK

Name: Charles Schelz **Email:** charlie_schelz@nps.gov

Name of institution represented: National Park Service

Purpose of study

The Mexican spotted owl (*Strix occidentalis lucida*) was listed as Threatened species in 1993 by the U.S. Fish and Wildlife (USDI 1993). Lands in Canyonlands National Park have been established as critical habitat by the U. S. Fish and Wildlife Service (2001). Canyonlands National Park is considered one of the major population centers of Mexican spotted owls on the Colorado Plateau. Surveys have been performed in Canyonlands in the past (Wiley 1995, 1997, 1998) but no monitoring of known territories or searches for new sites have been conducted since 1997. There are some areas in the park where we have reports of Spotted Owls but no official records of them.

Canyonlands NP has 20 historic sites throughout the three districts of the Park (Willey 1998). Most of the sites are in the Needles and Maze Districts. Despite intensive surveys, only 70-80% of potential habitat was checked for spotted owls (Willey 1998).

Most territories are centered around the core nest site which is located in rugged and steep canyon topography with vertical cliffs and numerous caves. Often with small patches of woodland vegetation, pinyon-juniper being the most common type. Canyonlands National Park is the center of this habitat type in southeastern Utah. This strong association between the owls and steep canyon topography suggests that this environment should be thoroughly surveyed and monitored.

The most important threat to the owl in Canyonlands National Park is increased human activities in the remote backcountry (Swarthout 1999). Swarthout concludes that high levels of recreational activity in nesting habitat maybe detrimental to Mexican spotted owls. This is why it is imperative that we know the location of the nesting habitat. To avoid a detrimental scenario.

OBJECTIVES: The goals of this project are to identify the distribution, abundance, and breeding status of Mexican spotted owls in Canyonlands National Park as part of the monitoring requirements of listing by the U.S. Fish and Wildlife Service. We will use the standard Mexican spotted owl survey manuals (Rinkevich 1991, Forseman 1983, Ganey 1988) as the main protocol guide.

Objective 1:

To inventory all known and potential Mexican spotted owl habitat in Canyonlands National Park.

Objective 2:
To document distribution, abundance, and breeding status of Mexican spotted owls in Canyonlands National Park.

Objective 3:
To map all survey routes and found Mexican spotted owl territories using GPS and GIS. To enter all survey results into the database management framework currently being developed by the Northern Colorado Plateau Inventory and Monitoring Network. This will help ensure the long-term security, compatibility, and accessibility of the data. And to create a final report summarizing all historic data and current inventory and monitoring results.